Monitoring 4D water temperature changes in San Francisco Bay–Delta Estuary using remote sensing and GIS spatial modeling
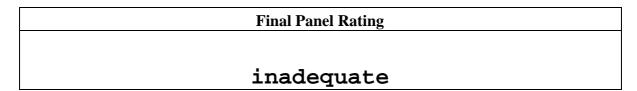
Minghua Zhang

Public Comments

No public comments were received for this proposal.

Technical Synthesis Panel Review

Proposal Title

#0329: Monitoring 4D water temperature changes in San Francisco Bay–Delta Estuary using remote sensing and GIS spatial modeling

Final Panel Rating
inadequate

Technical Synthesis Panel (Primary) Review

TSP Primary Reviewer's Evaluation Summary And Rating:

The objectives of the study are to develop a method based on remote sensing and GIS to produce 4 D water temperature distributions in the Bay-Delta. Such data would be useful, but the proposed approach is problematic. Algorithms for skin temperature (the very surface of the water) based on satellite-borne sensors exist, and do not need to be developed. Moreover, relating these results to the depth distribution with complex estuarine systems requires fairly sophisticated hydrodynamic models forced with appropriate meteorology. The simplistic GIS modeling based on the poorly designed field measurements being proposed is not sufficient. Furthermore, the utility of the temperature distributions to specific scientific or management issues are not clearly stated.

Additional Comments:

It is not possible to "model" vertical water temperature profiles in a bay from remote sensing surface temperature with a simple daily variation and without the consideration of the hydrodynamics. Water temperature should never be separated from salinity changes, freshwater discharge, tides, wind driven flows, mixing, and complicated bathymetry and

geomorphology. The study is not justified relative to existing knowledge. The PIs have no training and experience in hydrodynamics, oceanography, field observations, and interpretation. Their plans of work are simplistic and naive. The "model" they proposed is a single frequency daily variation. They assumed that the water temperature will only have regular sinusoidal daily changes due to solar radiation. In fact the water temperature variations are much more complicated than a superposition of a few frequencies. The water salinity, tidal currents, wind driven flows, and buoyancy driven flows are all important to the dynamics of the water. The turbulence mixing and stratification will be extremely complex such that the GIS "model" will not work. There is no simple relationship between the surface temperature and the vertical water temperature profiles. Even if there were, the relationship would not be resolved by a few measurements they proposed. The authors state "technology" goals but do not state what will be done with 4-D water temperature data. Which environmental dynamics functions require such detailed information? Generation of environmental datasets suppose to include goals on the data accuracy and hypotheses about the confidence levels for this new information. There is no discussion of such items in this proposal. Authors propose to develop "new algorithms". Why do the "old" algorithms need to be replaced? There are no goals (objectives) to identify limitations and the need to improve existing techniques. The use of remote sensing to generate data layers for GIS is not a new concept and numerous publications, as well as, on-line surface temperature maps are available from the NOAA/NASA data archive acquisition centers. It is not clear why authors need to develop their own algorithms. Prior to launch of satellites with Earth observing sensors, algorithm development teams are formed. Algorithms are pre-tested and undergo post-launch updates. The authors should acknowledge the existence of the documentation generated by these teams and propose improvements or regional fine-tuning.

The objectives of the study are to develop a method based on remote sensing and GIS to produce 4 D water temperature

distributions in the Bay-Delta. Such data would be useful, but the proposed approach is problematic. Algorithms for skin temperature (the very surface of the water) based on satellite-borne sensors exist, and do not need to be developed. Moreover, relating these results to the depth distribution with complex estuarine systems requires fairly sophisticated hydrodynamic models forced with appropriate meteorology. The simplistic GIS modeling based on the poorly designed field measurements being proposed is not sufficient. Furthermore, the utility of the temperature distributions to specific scientific or management issues are not clearly stated.

Technical Synthesis Panel (Discussion) Review

TSP Observations, Findings And Recommendations:

The external reviews ranged from "fair" to "very good", however, the two more positive reviews made substantial critical comments that did not match with their (relatively) high ranking of the proposal. The panel agreed with external reviewers that the approach presented here is problematic. The techniques used to develop surface temperature models from remote sensing data already exist (indeed, some of these methods were developed by the PI's). However, the applicants' plan to develop a model of the vertical distribution of temperature is poorly-conceived and will not produce credible products.

Rating: Inadequate

Technical Review #1

proposal title: Monitoring 4D water temperature changes in San Francisco Bay–Delta Estuary using remote sensing and GIS spatial modeling

Review Form

Goals

Are the goals, objectives and hypotheses clearly stated and internally consistent? Is the idea timely and important?

Comments	Yes, the goals, objectives and hypothese are clearly stated and internally consistent. However, the ideas don't appear to be attractive because the PIs proposed to "model" water temperture change and vertical structure throughout the large water system using "GIS" without the consideration of the hydrodynamics at all. This is not going to work.
Rating	fair

Justification

Is the study justified relative to existing knowledge? Is a conceptual model clearly stated in the proposal and does it explain the underlying basis for the proposed work? Is the selection of research, pilot or demonstration project, or a full–scale implementation project justified?

Comments	The study is not justified relative to existing knowledge. The PIs have NO prior training and experience in hydrodynamics, oceanography, field observations, and interpretation. They did not quote a SINGLE peer-reviewed physical oceanography work in the area. Their plans of work are extremely simplistic and naive. The "model" they proposed in Figure 4 is a single frequency daily variation. They assumed that the water temperature will only have regular sinusoidal daily changes due to solar radiation. Even high school students can tell you there is tidal

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variations also. In fact the water temperature
variations are much more complicated than a
superposition of a few frequencies. The water
salinity, tidal currents, wind driven flows, and
bouyancy driven flows are all important to the
dynamics of the water. The turbulence mixing and
stratification will be extremely complex such that the
GIS "model" will not work. There is no simple
relationship between the surface temperature and the
vertical water temperature profiles. Even if there
were, the relationship would not be resolved by a few
measurements they proposed.

I am quite astonished at reading this proposal.
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Rating	poor

Approach

Is the approach well designed and appropriate for meeting the objectives of the project? Is the approach feasible? Are results likely to add to the base of knowledge? Is the project likely to generate novel information, methodology, or approaches? Will the information ultimately be useful to decision makers?

Comments	The details of the approaches are not important any more because the proposed study is not well founded. GIS is only a tool that helps the visualization of geographic data. It can not be used to replace water dynamics. Without consideration of the water dynamics, there is no way to build a relationship between the water surface temperature and the vertical distribution of the temperature. Even today's most powerful numerical models cannot always reproduce the water temperature profiles, how can a GIS tool do that with a simple function?
Rating	poor

Feasibility

Is the approach fully documented and technically feasible? What is the likelihood of success? Is the scale of the project consistent with the objectives and within the grasp of authors?

Comments	There is no likelyhood of success for this work. As explained earlier, the PIs are not oceanographers, which could be OK with this reviewer if they can demonstrate that they have a clear idea of what they are proposing. The sampling plans are naive and there is no way that the data can help at all to biuld a "4-D" water temprature model. All oceanographers know that surface water temperature does not uniquely determine the temperature profiles.
Rating	poor

Monitoring

If applicable, is monitoring appropriately designed (pre−post comparisons; treatment−control comparisons)? Are there plans to interpret monitoring data or otherwise develop information?

Comments	No.
Rating	poor

Products

Are products of value likely from the project? Are contributions to larger data management systems relevant and considered? Are interpretive (or interpretable) outcomes likely from the project?

Comments	No value for any products out of this "4-D" water tempreature project.
Rating	poor

Additional Comments

Comments	Ecosystems respond to many factors including water temperature but not just water temperature. Salinity, river discharge, stratification, mixing, etc. all play a role. The PIs failed to prove in the beginning that water tempreature is THE factor that controls the ecosystem of the study area. The temperature variations have a wide spectrum and the proposal did not specify a particular scale that is of interest. They did not appear to have any idea about what they are proposing in terms of oceanography, signal-response of the system, prior studies and findings, and the dynamics of a water system.

Capabilities

What is the track record of authors in terms of past performance? Is the project team qualified to efficiently and effectively implement the proposed project? Do they have available the infrastructure and other aspects of support necessary to accomplish the project?

Comments	As I mentioned above, they did not have any track record in oceanography. They did not appear to know many people's work in the area with respect to the hydrodynamics. Their naive sampling plans tell me that they didn't seem to know anything about field work. Some of their terminologies are quite unusual and not commonly used in oceanography and hydrodynamics.
Rating	poor

Budget

Is the budget reasonable and adequate for the work proposed?

Comments	I don't need to comment on the budget given the above explanation. I don't think this proposal was given a critical consideration by the PIs themselves.
Rating	not applicable

Overall

Provide a brief explanation of your summary rating.

Comments	It is not possible to "model" vertical water temperature profiles in a bay from remote sensing surface temperature with a simple daily variation and without the consideration of the hydrodynamics. Water temperature should never be separated from salinity changes, freshwater discharge, tides, wind driven flows, mixing, and complicated bathymetry and geomorphology.
Rating	fair

Technical Review #2

proposal title: Monitoring 4D water temperature changes in San Francisco Bay–Delta Estuary using remote sensing and GIS spatial modeling

Review Form

Goals

Are the goals, objectives and hypotheses clearly stated and internally consistent? Is the idea timely and important?

Comments	The authors state "technology" goals but do not state what will be done with 4-D water temperature data. Which environmental dynamics functions require such detailed information? Generation of environmental datasets suppose to include goals on the data accuracy and hypotheses about the confidence levels for this new information. There is no discussion of such items in this proposal. Authors propose to develop "new algorithms". Why the "old" algorithms need to be replaced? There are no goals (objectives) to identivy limitations and the need to improve existing techniques. The use of remote sensing to generate data layers for GIS is not a new concept and numerous publications, as well as, on-line surface temperature maps are available from the NOAA/NASA data archive acquisition centres.
Rating	poor

Justification

Is the study justified relative to existing knowledge? Is a conceptual model clearly stated in the proposal and does it explain the underlying basis for the proposed work? Is the selection of research, pilot or demonstration project, or a full–scale implementation project justified?

Comments	There is USGS website (http://sfbay.wr.usgs.gov/access/wqdata/guide/toc.html)

	dedicated to the water quality and all relevant environmental variables. It looks like the authors did not research the state of the current knowledge. The authors list many different uses of the water temperature data but do not explain what spatial/temporal sampling of this variable is required for these applications and why data they will generate will be relevant. The retrieval of surface temperature using optical remote sensing data can not be carried out if there is a cloud cover or fog over area of interest. Thus, the autors should discuss how their method will account for this limiting factor.
Rating	fair

Approach

Is the approach well designed and appropriate for meeting the objectives of the project? Is the approach feasible? Are results likely to add to the base of knowledge? Is the project likely to generate novel information, methodology, or approaches? Will the information ultimately be useful to decision makers?

Comments	It is not clear why authors need to develop their own algorithms. Prior to launch of satellites with Earth observing sensors, algorithm development teams are formed. Algorithms are pre-tested and undergo post-launch updates. The authors should acknowledge the existance of the documentation generated by these teams and propose improvements or regional fine-tuning. In addition, the relationship between surface temperature and temperature profile (because of its complexity) requires more detailed analysis. There is no discussion on how the variability in the humidity (water vapour) or the surface roughness (wind speed) will affect the accuracy of retrievals.
Rating	good

Feasibility

Is the approach fully documented and technically feasible? What is the likelihood of success? Is the scale of the project consistent with the objectives and within the grasp of authors?

Comments	There is sufficient documentation within the proposal to carry out tasks proposed. The authors provide an extensive list of GIS tasks but ignore the limitations of using optical remote sensing imagery.
Rating	good

Monitoring

If applicable, is monitoring appropriately designed (pre–post comparisons; treatment–control comparisons)? Are there plans to interpret monitoring data or otherwise develop information?

Comments	Selection of an appropriate spatial interpolation and analysis tools are crucial for this type of project. The authors do not explain which techniques they will use to assure spatial and temporal accuracy for retrievals. The budget breakdown is not done by tasks. Thus, it is not clear whether sufficient effort will be dedicated to monitoring, statistical analysis, and interpretation of the results.
Rating	fair

Products

Are products of value likely from the project? Are contributions to larger data management systems relevant and considered? Are interpretive (or interpretable) outcomes likely from the project?

Comments	The main objective for this project is to develop a method for introducing into GIS remote sensing data. It is not clear what products will be delivered. There will be several reports generated available on-line but it is not clear who will be the user/reader of this information. The team members should identify

	their main clients, i.e., conduct user requirements/feedback survey prior or while operating the information distribution web site.
Rating	poor

Additional Comments

Comments	

Capabilities

What is the track record of authors in terms of past performance? Is the project team qualified to efficiently and effectively implement the proposed project? Do they have available the infrastructure and other aspects of support necessary to accomplish the project?

Comments	The project's team members have very good track record for past performance. The existing resources available are adequate to support this project.
Rating	good

Budget

Is the budget reasonable and adequate for the work proposed?

Comments	The budget breakdown per year does not seem to be proportional to the number of tasks carried out per year. The evaluation can not be done properly without breakdown by tasks/personnel. Overall it appears to be reasonable.
Rating	fair

Overall

Provide a brief explanation of your summary rating.

Comments	The proposal is well organized and contains detailed background and methodology explanations. It should

	include critical analysis of the results and a better definition of a product to be delivered. It is not clear what will this project generate that will be new. There are too many websites with imagery and on-line maps.
Rating	good

Technical Review #3

proposal title: Monitoring 4D water temperature changes in San Francisco Bay–Delta Estuary using remote sensing and GIS spatial modeling

Review Form

Goals

Are the goals, objectives and hypotheses clearly stated and internally consistent? Is the idea timely and important?

Comments	**The goal of the project is to measure timeseries of three-dimensional water temperature in the San Francisco Bay Delta Estuary. All of the objectives and hypotheses are directed toward this goal and the activities of the project all relate directly to this goal. The goal is important for water managers and the ideas employ state of the art technology, including remote sensing and GIS. The proposal clearly addresses an important topic for CALFED.**
Rating	**very good**

Justification

Is the study justified relative to existing knowledge? Is a conceptual model clearly stated in the proposal and does it explain the underlying basis for the proposed work? Is the selection of research, pilot or demonstration project, or a full–scale implementation project justified?

Comments	**The project is a full-scale implementation project combining measurements and interpolation methods to estimate water temperature nearly real time in the San Francisco Bay Delta Estuary. The study proposes new methods that should be investigated.** **The use and processing of the remote sensing data is clearly articulated and justified. The PIs are well-prepared to produce this data and this reviewer**

| | is convinced that all of their goals related to surface temperature would be reasonably achieved.

The sub-surface modeling and diurnal modeling, however, seem poorly formed and weakly argued (see Approach, below). It is this reviewer's opinion that the surface temperature measurements will be successful and that GIS will be capable of interpolating three-dimensional temperature data from the collected data, but that the sub-surface data will not be reliable. There is merit, however, in seeing how successful the method might be. |
| **Rating** | very good |

Approach

Is the approach well designed and appropriate for meeting the objectives of the project? Is the approach feasible? Are results likely to add to the base of knowledge? Is the project likely to generate novel information, methodology, or approaches? Will the information ultimately be useful to decision makers?

Comments	The surface temperature measurement from remote sensing data is well formulated and likely to be successful. The proposed method for subsurface temperature is to measure vertical variability of water temperature along transects at a few times and at a few points over long timeperiods. The hypothesis is that a consistent vertical profile can be related to surface water temperature and that a diurnal signal can be fit using a few satellite images during the day. Vertical profiles of temperature, however, cannot be predicted from measurements of surface temperature alone. In addition, there is almost no measureable diurnal signal in water temperature below the first few

	centimeters to one meter. It may be possible to predict vertical temperature profile changes using a thermal balance model if surface heat flux were measured continually, however, this is not proposed. Hence, the PIs need to better justify that surface temperature in the Estuary will be a good indicator of habitat suitability to the species of interest. Open questions that would improve the proposal include: To what depth does the remote sensing data integrate the temperature? What level of sub-surface accuracy is required? How persistent is the sub-surface profile of temperature across the estuary? Can the authors propose a temperature balance model that predicts sub-surface variability from surface heat flux? Nonetheless, the project will likely contribute important information about temperature variation in the estuary and should be seriously considered.
Rating	good

Feasibility

Is the approach fully documented and technically feasible? What is the likelihood of success? Is the scale of the project consistent with the objectives and within the grasp of authors?

Comments	The surface temperature measurements are feasible and the goals are likely to succeed. The sub-surface temperature measurements are also feasible, but likely inadequate to meet to stated goals of the project. Although there is some merit in attempting to interpolate sub-surface temperature based on surface

	temperature and a few point measurements, it is expected that the estimated data will have large errors. The methods are more suitable to shallower water bodies that do not have significant stratification or thermal inertia.
Rating	good

Monitoring

If applicable, is monitoring appropriately designed (pre–post comparisons; treatment–control comparisons)? Are there plans to interpret monitoring data or otherwise develop information?

Comments	The remote sensing aspects of the project are well designed. The sub-surface monitoring is inadequate to estimate three-dimensional temperature data from surface measurements. A better method would be to incorporate the surface temperature data with a three-dimensional process model for estuary circulation if real sub-surface temperature data is needed.
Rating	good

Products

Are products of value likely from the project? Are contributions to larger data management systems relevant and considered? Are interpretive (or interpretable) outcomes likely from the project?

Comments	The surface temperature maps will be of value to managers in the San Francisco Bay Delta Estuary. The sub-surface data will be much more limited in value, but will present the best estimate of the temperature distribution in the estuary for a relatively low data cost. Hence, it should be possible to estimate habitat for some species

	from the results of this project.
Rating	very good

Additional Comments

Comments	The main weakness of the sub-surface temperature measurements is the stated hypothesis. It is not likely that sub-surface temperature profiles can be estimated from surface temperature alone, at least not in an arbitrary estuary. Also, diurnal temperature variation is not likely to be important. A better hypothesis for the proposed activities is that temperature data interpolated as proposed here will capture an order-of-magnitude estimate for the thermal heat budget in the estuary system. It is more likely that average water temperatures can be estimated, not that actual sub-surface variability will be inferred from the surface variability.

Capabilities

What is the track record of authors in terms of past performance? Is the project team qualified to efficiently and effectively implement the proposed project? Do they have available the infrastructure and other aspects of support necessary to accomplish the project?

Comments	The project team has an excellent track record in remote sensing data. They also have access to the required data and propose a reasonable means of obtaining the sub-surface measurements. They are less qualified for understanding sub-surface temperature distributions, but their GIS expertise will allow them to perform their stated analyses.
Rating	very good

Budget

Is the budget reasonable and adequate for the work proposed?

Comments	The budget is reasonable and adequate. It does appear that travel funds for attending conferences is double-counted. $2000 per year in budget detail 4(d.) for presentations and $1500 in detail 5 for travel to conferences. Presumably the $2000 per year is for non-travel related expenditures?
Rating	excellent

Overall

Provide a brief explanation of your summary rating.

Comments	This is a reasonably priced proposal that will be very successful at estimating surface water temperature data from remotely sensed satellite imagery and will develop an interpolation method for estimating subsurface temperature. This reviewer is skeptical of their hypothesis that subsurface temperature can be related to surface temperature and that diurnal variation will be important. However, the project is still likely to make valuable contributions to measurement of water temperature in the San Francisco Bay Delta Estuary.
Rating	very good